Geophysical Research Abstracts
Vol. 20, EGU2018-16821, 2018
EGU General Assembly 2018

Use of a Vis-NIR spectroscopy index to estimate shallow soil salinity: an application in the Neretva River valley, Croatia

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Soil spectroscopy can provide low-cost and high-density data for predicting various soil properties. However, a relatively weak correlation between the spectra and the measurements of salinized soil properties makes spectroscopy difficult to use in salinity assessment, especially for low and moderately saline soils. The main objective of the study was to propose an approach based on Vis-NIR spectroscopy and geostatistics for mapping soil salinity in the Neretva river valley (Croatia). An effective spectral index (SI), which synthesizes some of saline soil properties, was defined and used as a covariate in ordinary cokriging (COK) for improving electrical conductivity (ECe) estimation. The proposed approach was compared with a univariate estimator (ordinary kriging, OK), which uses only ECe data and a multivariate estimator (ordinary cokriging, COK) using some chemical properties of primary importance in salt affected soils (Ca++,Mg++, Na+, SO4–,Cl- concentrations and pH) as covariates . The study was carried out in an agricultural area (5068 ha) located in the Neretva River valley (Croatia). Topsoil (0-30 cm) samples were collected at 245 locations with a grid (500 m x 500 m) sampling scheme and analyzed for some chemical and physical properties. Moreover, soil samples were used for visible and near red (Vis-NIR) spectra measurements with a range of wavelength between 350 and 2500 nm. The spectral data were preprocessed and ECe was estimated by partial least squares regression (PLSR). The first significant latent variable that accounted for 85% of the total variance was selected and used as a SI to quantify and map spatial variation of soil salinity. The univariate and multivariate geostatistical approaches provided results and performances quite similar. Regarding the two multivariate approaches, the one using the spectral index has provided better results in terms of unbiasedness and accuracy. The spectral index SI, besides providing accurate estimates of ECe, is also very cost-effective and it would then make possible broad-scale surveys for soil salinity assessment at landscape scale.